

REMARKS

*covered
multiple times*

In the Office Action, the Examiner in paragraph 2 included claim 30 in the list of claims withdrawn from consideration or drawn to a non-elected species. However, claim 30 is drawn to the elected species as indicated by applicant's response dated October 11, 2001. The Examiner's inclusion of claim 30 in the list of claims withdrawn from consideration is believed to be a typographical error since it had previously been included in the claims acted upon and was acted upon in the Final Rejection.

The Examiner is thanked for the courtesy of the interview granted in the above-identified application. At the interview proposed amendments to the claims, the specification, and the drawings were discussed. The above amendment implements the proposed amendments. Submitted herewith by separate letter are proposed new Figures 2a and 2b used to explain the operation of the robot arm mechanism of the invention. These figures were proposed to the Examiner at the interview.

In the Office Action the Examiner contended that the previous amendments to the specification and claims were not supported by the original disclosure and constituted new matter. The Examiner required these amendments to be canceled. In addition the Examiner rejected the claims as being indefinite because the Examiner considered the amended claim language to be unclear.

In the original specification and claims, the link retaining mechanism was described as keeping parallel two lines. Specifically, the link retaining mechanism 200 shown in Figure 2, was described on page 7 as keeping "parallel two lines of the line passing through the first and second end portions of the first arm link 811 and the symmetrical line with respect to the center line 201 with the line passing through the first and second end portions of the second arm link 812." In the initial Office Action the Examiner objected to this language as being unclear and rejected the claims which recited this language as being indefinite. What the language in question is saying is that the robot arm mechanism keeps two lines of the mechanism in a parallel relationship and that one of the lines is a line passing through the end portions of the arm link 811 and that the other line is a line symmetrical with respect to the center line 201 with the line passing through the end portions of the second arm link 812 as now shown in the new Figures 2a and 2b. Figure 2a shows the specific arrangement of Figure 2 wherein the two lines L1 and L2 are maintained colinear and Figure 2b shows the two lines L1 and L2 being

maintained parallel but not colinear. This mechanism is now clearly explained in the specification as amended. Since the amended portion of the specification on page 7 describes essentially the same thing as the original language in the specification, it is submitted that the new revised language is not new matter and that the revised language is supported by the original specification.

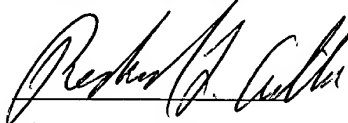
The language in the other paragraphs describing the parallel relationship and objected to by the Examiner as containing new matter has been amended in a manner similar to the paragraph beginning at page 7, line 2. Likewise the claim language also objected to by the Examiner as containing new matter has been amended to the language corresponding to that now used in the paragraph beginning on page 7, line 2. Accordingly, it is submitted that the Examiner's objection to the specification and claims as containing new matter is no longer applicable. Similarly it is submitted that the rejection of the claims as being indefinite is no longer applicable since the claim language subject to the objection has been revised.

In the Office Action the Examiner had objected to the drawings on the grounds that they did not show the parallel relationship being claimed in the claims. New Figures 2a and 2b clearly show the parallel relationship being claimed and accordingly it is submitted that this objection to the drawings is no longer applicable.

In view of the foregoing it is submitted that this application is now in condition for allowance and favorable reconsideration thereof is earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Paragraph beginning at page 2, line 7 has been amended as follows:

According to the first aspect of the present invention there is provided a robot arm mechanism comprising: a handling member for supporting and handling an object; a robot arm connected to the handling member, the robot arm comprising a first arm link having first and second end portion, a second arm link having first and second end portion, and a link retaining mechanism having a center line, the link retaining mechanism pivotably retaining the first and second arm links respectively at the first end portions of the first and second arm links and keeping parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link and the second line being a line symmetrical with respect to the center line with the line passing through the first and second end portions of the second arm link,~~ the link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the link retaining mechanism, the first short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism and the second short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the link retaining mechanism, the second short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the link retaining

mechanism, the second long link of the first joint cross linkage of the link retaining mechanism and the first short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the link retaining mechanism under the state that the second long link of the first joint cross linkage of the link retaining mechanism is crossed with the first long link of the first joint cross linkage of the link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the link retaining mechanism, the first short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the link retaining mechanism, the first long link of the second joint cross linkage of the link retaining mechanism and the second short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the link retaining mechanism, the second short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the link retaining mechanism, the second long link of the second joint cross linkage of the link retaining mechanism and the first short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism under the state that the second long link of the second joint cross linkage of the link retaining mechanism is

crossed with the first long link of the second joint cross linkage of the link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the link retaining mechanism to each of the first and second long links of the first joint cross linkage of the link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the link retaining mechanism to each of the first and second long links of the second joint cross linkage of the link retaining mechanism, the first short link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of any one of the first and second arm links integrally formed with the second short link of the first joint cross linkage of the link retaining mechanism, the first end portion of the other one of the first and second arm links integrally formed with the second long link of the second joint cross linkage of the link retaining mechanism; and a robot arm driving mechanism for driving the robot arm.

Paragraph beginning at page 7, line 2 has been amended as follows:

The link retaining mechanism 200 pivotably retains the first and second arm links 811 and 812 respectively at the first end portions of the first and second arm links 811 and 812 and keeps parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link 811 and the second line being a line~~ symmetrical with respect to the center line 201 with the line passing through the first and second end portions of the second arm link 812. In fact the first and second arm links 811 and 812 are in symmetrical relationship with each other with respect to the center line 201. The above-described parallel relationship is illustrated in Figures 2a and 2b. Figure 2a illustrates the specific

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relationship shown in Figure 2 wherein the first line L1 passing through the first and second end portions of the link 811 is maintained colinear with the line L2, which is symmetrical with respect to the center line 201 with the line passing through the first and second end portions of the second arm link 812. Figure 2b illustrates the parallel relationship wherein the first line L1 passing through the first and second end portions of the link 811 is maintained parallel, but not colinear, with the second line L2 which is symmetrical with respect to the center line 201 with the line passing through the first and second end portions of the second arm link 812.

Paragraph beginning at page 12, line 26 has been amended as follows:

The link retaining mechanism 200 pivotably retains the first and second arm links 821 and 822 respectively at the first end portions of the first and second arm links 821 and 822 and keeps parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link 821 and the second line being a line symmetrical with respect to the center line 201 with the line passing through the first and second end portions of the second arm link 822.~~ The first end portion of the first arm link 821 is integrally formed with the second short link 213. The first end portion of the second arm link 822 is integrally formed with the second long link 224. The first end portions of the first and second arm links 821 and 822 are positioned on the center line 201. In fact the first and second arm links 821 and 822 are in symmetrical relationship with each other with respect to the center line 201.

Paragraph beginning at page 15, line 25 has been amended as follows:

The link retaining mechanism 300 pivotably retains the first and second arm links 831 and 832 respectively at the first end portions of the first and second arm links 831 and 832 and keeps parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link 831 and the second line a line symmetrical with respect to the center line 301 with the line passing through the first and second end portions of the second arm link 832.~~

Paragraph beginning at page 20, line 7 has been amended as follows:

The link retaining mechanism 350 pivotably retains the first and second arm links 851 and 852 respectively at the first end portions of the first and second arm links 851 and 852 and keeps parallel ~~two lines including~~ a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link 851 and the second line being a line symmetrical with respect to the center line 351 with the line passing through the first and second end portions of the second arm link 852.

Paragraph beginning at page 23, line 17 has been amended as follows:

The robot arm 880 further comprises a fifth arm link 885 having first and second end portion, a sixth arm link 886 having first and second end portion, and an additional link retaining mechanism 250 having an additional center line 251. The additional link retaining mechanism 250 pivotably retains the fifth and sixth arm links 885 and 886 respectively at the first end portions of the fifth and sixth arm links 885 and 886 and keeps parallel ~~two lines including a~~ first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link 885 and the second line being a line symmetrical with respect to the additional center line 251 with the line passing through the first and second end portions of the sixth arm link 886. In fact the fifth and sixth arm links 885 and 886 are in symmetrical relationship with each other with respect to the center line 251.

Paragraph beginning at page 26, line 11 has been amended as follows:

The link retaining mechanism 400 pivotably retains the first and second arm links 891 and 892 respectively at the first end portions of the first and second arm links 891 and 892 and keeps parallel ~~two lines including~~ a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link 891 and the second line being a line symmetrical with respect to the center line 401 with the line passing through the first and second end portions of the second arm link 892. In fact the first and second arm links 891 and 892 are in symmetrical relationship with each other with respect to the center line 401.

Paragraph beginning at page 29, line 28 has been amended as follows:

The link retaining mechanism 500 pivotably retains the first and second arm links 901 and 902 respectively at the first end portions of the first and second arm links 901 and 902 and

keeps parallel ~~two lines including a first line and a second line, the first line being~~ a line passing through the first and second end portions of the first arm link 901 and ~~the second line being~~ a line symmetrical with respect to the center line 501 with the line passing through the first and second end portions of the second arm link 902. In fact the first and second arm links 901 and 902 are in symmetrical relationship with each other with respect to the center line 501.

Paragraph beginning at page 35, line 37 has been amended as follows:

The robot arm 930 further comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retains the fifth and sixth arm links 935 and 936 respectively at the first end portions of the fifth and sixth arm links 935 and 936 and keeps parallel ~~two lines including a first line and a second line, the first line being~~ a line passing through the first and second end portions of the fifth arm link 935 and ~~the second line being~~ a line symmetrical with respect to the additional center line 451 with the line passing through the first and second end portions of the sixth arm link 936. In fact the fifth and sixth arm links 935 and 936 are in symmetrical relationship with each other with respect to the additional center line 451.

Paragraph beginning at page 38, line 28 has been amended as follows:

The robot arm 940 further comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retains the fifth and sixth arm links 945 and 946 respectively at the first end portions of the fifth and sixth arm links 945 and 946 and keeps parallel ~~two lines including a first line and a second line, the first line being~~ a line passing through the first and second end portions of the fifth arm link 945 and ~~the second line being~~ a line symmetrical with respect to the additional center line 451 with the line passing through the first and second end portions of the sixth arm link 946. In fact the fifth and sixth arm links 945 and 946 are in symmetrical relationship with each other with respect to the additional center line 451.

Paragraph beginning at page 40, line 18 has been amended as follows:

The robot arm 950 further comprises a fifth arm link 955 having first and second end portion and a sixth arm link 956 having first and second end portion. The robot arm 950 further

comprises an additional link retaining mechanism 450 having an additional center line 451. The additional link retaining mechanism 450 pivotably retains the third and fourth arm links 953 and 954 respectively at the first end portions of the third and fourth arm links 953 and 954 and keeps parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the third arm link 953 and the second line being a line symmetrical with respect to the additional center line 451 with the line passing through the first and second end portions of the fourth arm link 954.~~ In fact the third and fourth arm links 953 and 954 are in symmetrical relationship with each other with respect to the additional link retaining mechanism 450.

In the Claims

Claim 1 has been amended as follows:

1. (Twice Amended) A robot arm mechanism comprising:
 - a handling member for supporting and handling an object;
 - a robot arm connected to the handling member, the robot arm comprising a first arm link having first and second end portion, a second arm link having first and second end portion, and a link retaining mechanism having a center line, the link retaining mechanism pivotably retaining the first and second arm links respectively at the first end portions of the first and second arm links and keeping parallel ~~two lines including a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link and the second line being a line symmetrical with respect to the center line with the line passing through the first and second end portions of the second arm link,~~ the link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the link retaining mechanism, the first short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining

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mechanism and the second short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the link retaining mechanism, the second short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the link retaining mechanism, the second long link of the first joint cross linkage of the link retaining mechanism and the first short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the link retaining mechanism under the state that the second long link of the first joint cross linkage of the link retaining mechanism is crossed with the first long link of the first joint cross linkage of the link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the link retaining mechanism, the first short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the link retaining mechanism, the first long link of the second joint cross linkage of the link retaining mechanism and the second short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the link retaining mechanism, the second short and long

links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the link retaining mechanism, the second long link of the second joint cross linkage of the link retaining mechanism and the first short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism under the state that the second long link of the second joint cross linkage of the link retaining mechanism is crossed with the first long link of the second joint cross linkage of the link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the link retaining mechanism to each of the first and second long links of the first joint cross linkage of the link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the link retaining mechanism to each of the first and second long links of the second joint cross linkage of the link retaining mechanism, the first short link of the first joint cross linkage of the link retaining mechanism integrally formed with and in axial alignment with the first long link of the second joint cross linkage of the link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in axial alignment with the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of any one of the first and second arm links integrally formed with the second short link of the first joint cross linkage of the link retaining mechanism, the first end portion of the other one of the first and second arm links integrally formed with the second long link of the second joint cross linkage of the link retaining mechanism; and
a robot arm driving mechanism for driving the robot arm.

Claim 8 has been amended as follows:

8. (Twice Amended) A robot arm mechanism as set forth in claim 7 in which the robot arm further comprises:

a fifth arm link having first and second end portion;

a sixth arm link having first and second end portion;

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel ~~two lines including~~ a first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining

mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the

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additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the additional center line, the second end portion of the first arm link and the first end portion of the third arm link connected with each other, the

second end portion of the second arm link and the first end portion of the fourth arm link connected with each other, the first long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism substantially equal in length to each other, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism;

a first stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the first arm link, the first link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the first arm link under the state that the first end portion of the first link of the first stabilizing parallelogram linkage is connected with the first end portion of the first arm link, a second link having first and second end portions and substantially equal in length to the fifth arm link, the first and second links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the first stabilizing parallelogram linkage and the first end portion of the second link of the first stabilizing parallelogram linkage, the second link of the first stabilizing parallelogram linkage integrally formed with and in parallel relationship with the third arm link under the state that the first end portion of the second link of the first stabilizing parallelogram linkage is connected with the first end portion of the third arm link, a third link having first and second end portions and substantially equal in length to the first link of the first stabilizing parallelogram linkage, the second and third links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the first stabilizing parallelogram linkage and the first end portion of the third link of the first stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the first stabilizing parallelogram linkage, the third and fourth links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the first stabilizing parallelogram linkage and the first end portion of the fourth link of the first stabilizing parallelogram linkage, the fourth and first links of the first stabilizing parallelogram linkage

pivotably connected with each other at the second end portion of the fourth link of the first stabilizing parallelogram linkage and the first end portion of the first link of the first stabilizing parallelogram linkage under the state that the first link of the first stabilizing parallelogram linkage is in parallel relationship with the third link of the first stabilizing parallelogram linkage and that the second link of the first stabilizing parallelogram linkage is in parallel relationship with the fourth link of the first stabilizing parallelogram linkage, the fourth link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the fifth arm link under the state that the second end portion of the fourth link of the first stabilizing parallelogram linkage is connected with the first end portion of the fifth arm link; and

a second stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the second arm link, the first link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the second arm link under the state that the first end portion of the first link of the second stabilizing parallelogram linkage is connected with the first end portion of the second arm link, a second link having first and second end portions and substantially equal in length to the sixth arm link, the first and second links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the second stabilizing parallelogram linkage and the first end portion of the second link of the second stabilizing parallelogram linkage, the second link of the second stabilizing parallelogram linkage integrally formed with and in parallel relationship with the fourth arm link under the state that the first end portion of the second link of the second stabilizing parallelogram linkage is connected with the first end portion of the fourth arm link, a third link having first and second end portions and substantially equal in length to the first link of the second stabilizing parallelogram linkage, the second and third links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the second stabilizing parallelogram linkage and the first end portion of the third link of the second stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the second stabilizing parallelogram linkage, the third and fourth links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the second stabilizing parallelogram linkage and the first end portion of the fourth link of the second stabilizing parallelogram linkage, the fourth and first links of the

second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the fourth link of the second stabilizing parallelogram linkage and the first end portion of the first link of the second stabilizing parallelogram linkage under the state that the first link of the second stabilizing parallelogram linkage is in parallel relationship with the third link of the second stabilizing parallelogram linkage and that the second link of the second stabilizing parallelogram linkage is in parallel relationship with the fourth link of the second stabilizing parallelogram linkage, the fourth link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the sixth arm link under the state that the second end portion of the fourth link of the second stabilizing parallelogram linkage is connected with the first end portion of the sixth arm link.

Claim 22 has been amended as follows:

22. (Twice Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:

a fifth arm link having first and second end portion;

a sixth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel ~~two lines including~~ a first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially

equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end

portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the

second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first joint mechanism retaining the fifth arm link at the second end portion of the fifth arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the third arm link, the second joint mechanism retaining the sixth arm link at the second end portion of the sixth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the fourth arm link.

Claim 25 has been amended as follows:

25. (Twice Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:

a fifth arm link having first and second end portion;

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a sixth arm link having first and second end portion;
a seventh arm link having first and second end portion;
a eighth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other, the seventh and eighth arm links substantially equal in length to each other;

a third joint mechanism retaining the fifth and seventh arm links respectively at the second end portion of the fifth arm link and the first end portion of the seventh arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the seventh arm link;

a fourth joint mechanism retaining the sixth and eighth arm links respectively at the second end portion of the sixth arm link and the first end portion of the eighth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the eighth arm link; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel ~~two lines including~~ a first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical line with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first

long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of

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the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links

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integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, any one of the first and second driving shafts rotating the eighth arm link around the second end portion of the eighth arm link, the other one of the first and second driving shafts rotating the seventh arm link around the second end portion of the seventh arm link, the second end portions of the eighth and seventh arm links positioned on the rotation axis.

Claim 28 has been amended as follows:

28. (Twice Amended) A robot arm mechanism as set forth in claim 16 which further comprising an additional handling member, the robot arm further comprising:

- a third arm link having first and second end portion;
- a fourth arm link having first and second end portion, the first, second, third, and fourth arm links substantially equal in length to each other;
- a fifth arm link having first and second end portion;
- a sixth arm link having first and second end portion; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the third and fourth arm links respectively at the first end portions of the third and fourth arm links and keeping parallel ~~two lines including a~~ first line and a second line, the first line being a line passing through the first and second end portions of the third arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the fourth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the

additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross

linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the third and fourth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the third and fourth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the handling member having a first and second portions, the additional handling member having a first and second portions, the first arm link and the handling member pivotably connected with each other at the second end portion of the first arm link and the first portion of the handling member, the third arm link and the handling member pivotably connected with each other at the second end portion of the third arm link and the second portion of the handling member, the fourth arm link and the additional handling member pivotably connected with each

other at the second end portion of the fourth arm link and the first portion of the additional handling member, the second arm link and the additional handling member pivotably connected with each other at the second end portion of the second arm link and the second portion of the additional handling member, the arm driving mechanism comprising a first driving shaft rotatable around a rotation axis, and a second driving shaft in the form of a hollow shape to rotatably receive therein the first driving shaft and rotatable around the rotation axis, any one of the first and second driving shafts rotating the fifth arm link around the second end portion of the fifth arm link, the other one of the first and second driving shafts rotating the sixth arm link around the second end portion of the sixth arm link, the second end portions of the fifth and sixth arm links positioned on the rotation axis, the fifth arm link pivotable around the second end portion of the fifth arm link, the sixth arm link pivotable around the second end portion of the sixth arm link, the first end portion of the fifth arm link pivotally connected with the first long link of the first joint cross linkage of the link retaining mechanism or the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the fifth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of the sixth arm link pivotally connected with the first long link of the first joint cross linkage of the additional link retaining mechanism or the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the sixth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism.